REMARKS

This amendment is responsive to the office action dated January 27, 2005. Claims 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 33, 39, 41 and 45 have been rejected. Claims 31, 35, 37, 43 and 47-53 are withdrawn from consideration. Reexamination is respectfully requested in light of the following amendments in the specification, drawings and claims.

A summary of the amendments in the claims is as follows:

(Claim 1) former Claims 1 + 3 + 5 + 11

In addition, the target of application was limited to synthesis of a heat-radiation light source spectrum. The amendment stands on the description in the second paragraph on page 11 of the specification, which appears as "One possible visible continuous spectrum to be modeled upon is a continuous spectrum obtained from a heat-radiation light source."

Claims 3, 5 and 11 were canceled as a result of inclusion into Claim 1.

Claim 11 means, as is known from Fig. 4 or Fig. 7, that depth of well (energy difference between bottoms of the conduction bands or tops of the valence bands of the barrier layer B and well layer W) in the band structure of the well layer composing the unit layer becomes larger in the well having a shorter emission wavelength, and was included into Claim 1 after being amended so as to help easy understanding.

Claims 7, 13, 19, 21, 25, 33, 39 and 45 were amended so as to be dependent to Claim 1.

ELECTION/RESTRICTIONS

Claims 31, 35, 37, 43 and 47-53 which have been withdrawn from consideration are cancelled in order to place the case in condition for allowance.

DRAWINGS

Reference numerals 11, 21, 71, 151 and 174 in Figs. 22, 24 and 25, which were pointed out as being not described in the detailed description, were deleted.

It is to be noted that "12107531" found in Fig. 24 is an IC terminal number indicated on a package of BP5057-15, product of Rohm Co., Ltd, JAPAN, cited as an example of a power source IC102 in this patent specification, and is not a reference numeral.

Reference numeral 30 in Fig. 24 was erroneous, and was corrected to 50.

Reference numerals 10 and 20 for the light emitting devices were added to Fig. 22 and Fig. 25.

As for reference numerals 111, 121, 99 and 61, amendments were made on the individual portions pointed out by the Examiner, in order to unify the name of objects to be given with these reference numerals.

IN THE SPECIFICATION

The title has been changed to reflect the invention as requested.

Table 3 and Table 5 showed wrong values for band gap energy Eg of the layers 1 and 2, so that the values were corrected to appropriate values unambiguously determined from the wavelength values.

As to the amendments to Tables 3 and 5, the priority document also shows erroneous values. The Eg values before amendment do not correspond to the wavelength and, therefore, the amendments are made to make them correspond to the wavelength. The amended Eg values can be unambiguously determined by calculation for persons skilled in the art.

CLAIM REJECTIONS UNDER 35 USC § 112

The rejection under 35 USC §112 part (a) is respectfully traversed. The limitative condition of "5% or more of the reference intensity" is provided for the purpose of excluding such formal inclusion of the prior art, and we believe that those skilled in the art can thoroughly understand the effect of the present invention of "capable of synthesizing a continuous spectrum of a heat-radiation light source in a simulative manner", which can never be predicted from the prior art, without special reinforcement by data.

The rejection under 35 USC §112 part (b) is respectfully traversed since the corresponding part of claim 11 (now incorporated in the amended claim1) is amended as follows "wherein the well-depth of the well layers in the emission unit layer is getting

smaller with being shorter the emission wavelength." The 'depth' means the difference of the bottom energy level of conduction bands or the top energy level of valence band between the barrier layer and the well layer.

The rejection under 35 USC §112 part (c) is respectfully traversed since the corresponding part of claim 21 is amended as follows " wherein a plurality of repetitive units consisting of a set of emission unit layers having different emission wavelengths are periodically formed in the thickness-wise direction of the active layer."

PRIOR ART REJECTIONS

Amended Claim 1 is as follows:

(Claim 1)

A light emitting device causing emission output of a light having a pseudo-continuous spectrum which is modeled upon a continuous spectrum obtained from a heat-radiation light source obtained by synthesizing a plurality of emissions differing in peak wavelength so as to ensure an effective wavelength region showing an emission intensity of 5% or more of a reference intensity over a wavelength region of 50 nm or more, the reference intensity being defined as an emission intensity at a peak wavelength in the synthesized spectrum,

having a double hetero light emitting layer portion composed of compound semiconductors, the double hetero light emitting layer portion having an active layer comprising a plurality of emission unit layers differing from each other in band gap energy, and the emission output of the light having a pseudo-continuous spectrum is

ascribable to a combination of light emission from the individual emission unit layers,

wherein the emission unit layers comprise well layers each of which is sandwiched by two barrier layers,

wherein the well-depth of the well layers in the emission unit layer is adjusted as being getting smaller as the emission wavelength becomes shorter.

By the above underlined portion of amended claim 1, Applicant has added a new limitation which makes it unnecessary to address any of the rejections based upon In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). The basis in the specification for this amendment is found at page 11, lines 7-10. The ATTACHED SKETCHES show drawings which help with understanding of the discussion of the invention which follows.

Claim 1 after the amendment directed to synthesizing a broad continuous spectrum (SKETCH 3) emitted from a heat-radiation light sources such as sunlight (ca. 6000K), incandescent lamp (ca. 3000K) or combustion light (ca. 1500K), by combining monochromatic light spectra (unit light emission), each of which having a narrow half-value width ascribable to a unit layer, having various band gap energies, incorporated in an active layer of a light emitting device (SKETCH 2), to thereby realize a light source having a spectral form similar to that of the light emitted from the heat-radiation light source.

What is disclosed in the cited reference is a light source, as shown in reference drawing (SKETCH 1, prior art), designed to combine monochromatic light emissions of

RGB, which are three principal colors of light. so as to obtain a desired emission color depending on a ratio of mixing of RGB. The monochromatic emissions of RGB are, however, distant from each other by a wavelength interval of 100 nm or more, and the half-value widths of each of the monochromatic light emissions is narrow, so that the adjacent monochromatic emission spectra almost cannot be continuous, but remains discontinuous. In other words, wavelength regions showing nearly zero intensities are formed between every adjacent monochromatic light spectra (SKETCH 1). This is incapable of synthesizing spectral forms of lighting with heat-radiation light sources. Peak wavelength of the a synthetic spectrum obtained in this case will be represented by a peak wavelength of a monochromatic light of the largest emission intensity, and based on the definition of the Claim, assuming the emission intensity at such peak wavelength as a reference intensity, the width of a wavelength range (effective wavelength range) capable of showing 5% or more of the reference intensity will surely be 40 nm or less, corresponding to the half-value width of the monochromatic light.

More specifically, the fact that "the width of an effective wavelength range capable of showing 5% or more of the reference intensity is 40 nm or less" means that the trails of the adjacent monochromatic spectra cannot be continuous because of too large peak-to-peak wavelength distance, so far as light emissions from a plurality of well layers of a semiconductor light emitting device are used, just like the case where the RGB monochromatic lights are combined, and means that it is impossible to synthesize spectral forms of lighting with heat-radiation light sources.

The amended present invention ensures the width of the effective wavelength

range showing 5% or more of the reference intensity as wide as 50 nm or more, when light emissions from a plurality of well layers of a semiconductor device are used. A single monochromatic light from a well layer can provide an effective wavelength range of as small as 40 nm or less, as described in the above. "Ensuring the effective wavelength range as wide as 50 nm or more" therefore means, as shown in the reference drawing (SKETCH 2, this invention), that a larger number of monochromatic spectral sources (i.e., well layer) are combined at intervals of wavelength shorter than that of the RGB monochromatic arrangement, so as to make the trails of every adjacent monochromatic spectra continuous. In other words, such continuity in the trails of spectra of every adjacent monochromatic light emissions is successful in excluding wavelength regions showing almost zero intensities, and will provide the first technique to successfully synthesize a spectral form of lighting with heat-radiation light sources.

It is to be noted herein that the phrase of "modeled upon a continuous spectrum obtained from a heat-radiation light source" means that peak positions of emission spectra obtained from the individual unit layers are arranged along the outer contour of the continuous spectrum of a heat-radiation light source to be modeled upon, as shown in Fig. 17 or Fig. 18.

The concept of synthesizing a spectral form of lighting with a heat-radiation light source based on combination of monochromatic lights having overlapped trails is absolutely not disclosed in the prior art which is aimed at synthesizing a emission color based on ratio of RGB mixing. The present invention, however, raises a nonconformity of formally including the prior art based on combination of the RGB monochromatic light

arrangement, because even the monochromatic lights having distant peak wavelengths such as those in the RGB arrangement can cause a slight overlapping of the spectral trails if strictly interpreted in a sense of quantum mechanics (of course, the interpretation is meaningless from a technical point of view).

KOIKE

Koike discloses only a combination of RGB emission, as shown in Fig. 1, which is incapable of synthesizing a continuous spectrum of a heat-radiation light source in a simulative manner. Therefore, the disclosure by Koike does not form any ground of denying the step in lines 2 and 3 of amended Claim 1 which is "which is modeled upon is a continuous spectrum obtained from a heat-radiation light source".

There is absolutely no description by Koike also with respect to the requirement that the well layer is configured so that a unit layer having a shorter emission wavelength will have a smaller depth. We anticipate that the Examiner might unfortunately misunderstand this point. Making a well layer having a shorter emission wavelength have a smaller depth should inevitably need a certain level of efforts of typically adjusting energies of the bottom of the conduction band and the top of the valence band of the barrier layer into a predetermined level as shown in Fig. 4 to Fig. 7 of the present invention, whereas Koike neither gives relevant illustrations in the drawings nor suggestion by words in the description.

CLAIMS 25, AND 29

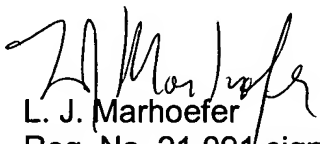
Also comparison for the principal dependent Claims will be given below. According to Claim 25, the plurality of emission unit layers are aligned according to an order of magnitude of the band gap energy such as ensuring a difference of 0.2 eV or less between every adjacent band gap energies. In the RGB combination by Koike, distance between the peak wavelengths of G and B, or between the peak wavelengths of G and R is as large as 100 nm or more, or 0.47 eV when converted into a difference value between band gap energies, which is considerably wide. It is a matter of course that the trails of the adjacent monochromatic light spectra will never overlap with each other. Whereas, the difference value between the adjacent band gap energies adjusted to as small as 0.2 eV or less makes it possible to considerably increase amount of overlapping of the trails of the adjacent monochromatic light spectra, and to obtain a pseudo-continuous spectrum of a heat-radiation light source only with a less amount of ripple.

Claim 29 assumes a ripple ratio of the pseudo-continuous spectrum (d/H in Fig. 35) suppressed to as small as 0.1 or less. The case of Koike has wavelength regions showing substantially zero intensities between every adjacent spectral peaks of the individual monochromatic lights of RGB, as shown in the reference drawing (prior art), indicating a ripple ratio of 1 (i.e., 100%) according to the definition shown in Fig. 35. This intrinsically prevents a concept of synthesizing a pseudo-continuous spectrum from being established. Claim 29 is intended for reducing the ripple ratio of Koike by 1/10 times or more, or by a single order of magnitude or more, so that it is obvious that

the present invention is successful in more closely assimilating a spectrum of a heat-radiation light source.

In view of the foregoing, it is respectfully submitted that the application is now in condition for allowance, and early action in accordance thereof is requested. In the event there is any reason why the application cannot be allowed in this current condition, it is respectfully requested that the Examiner contact the undersigned at the number listed below to resolve any problems by Interview or Examiner's Amendment.

Respectfully submitted,



L. J. Marhoefer
Reg. No. 21,091 signing for
Ronald R. Snider
Reg. No. 24,962

Date: May 26, 2005

Snider & Associates
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AMENDMENTS TO THE DRAWINGS:

The attached five sheets of drawings include changes to Figures 22 to 26. The sheet, which includes Figure 22, replaces the original sheet with Figure 22. The sheet, which includes Figure 23, replaces the original sheet with Figure 23. The sheet, which includes Figure 24, replaces the original sheet with Figure 24. The sheet, which includes Figure 25, replaces the original sheet with Figure 25. The sheet, which includes Figure 26, replaces the original sheet with Figure 26. The sheet, which includes Figure 33, replaces the original sheet with Figure 33.

In Figure 22, the reference numbers "10" and "20" have been added and the reference numbers "71" and "174" have been deleted.

In Figure 23, the reference numbers "11" and "21" have been deleted.

In Figure 24, the reference number "30" has been changed to "50".

In Figure 25, the reference numbers "10" and "20" have been added and the reference numbers "89" and "151" have been deleted.

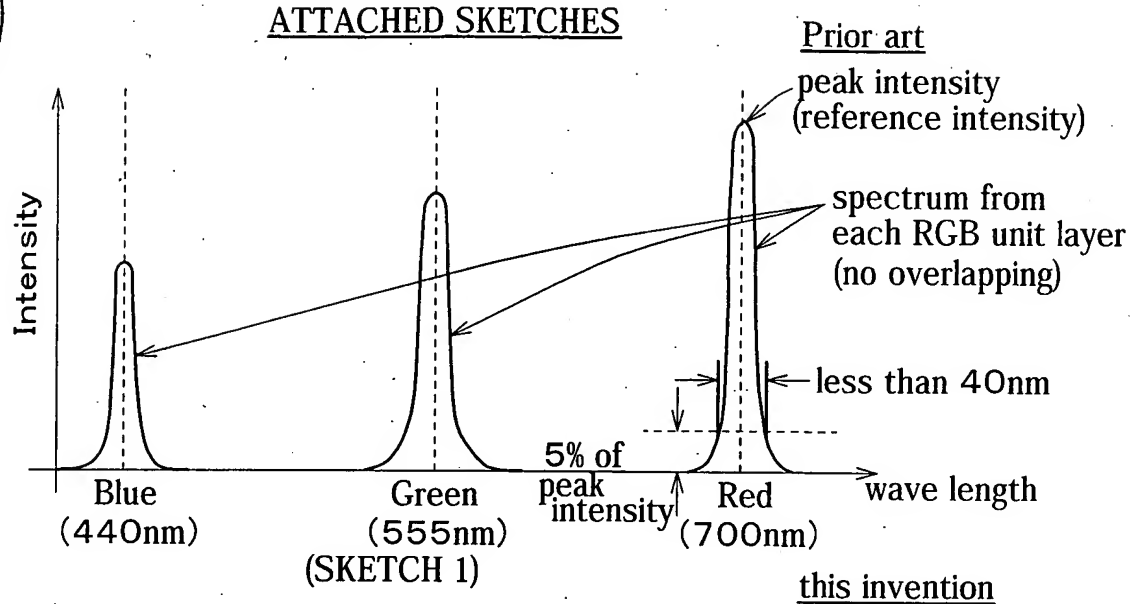
In Figure 26, the reference number "89" has been deleted.

In Figure 33, the reference number "62" has been changed to "63"

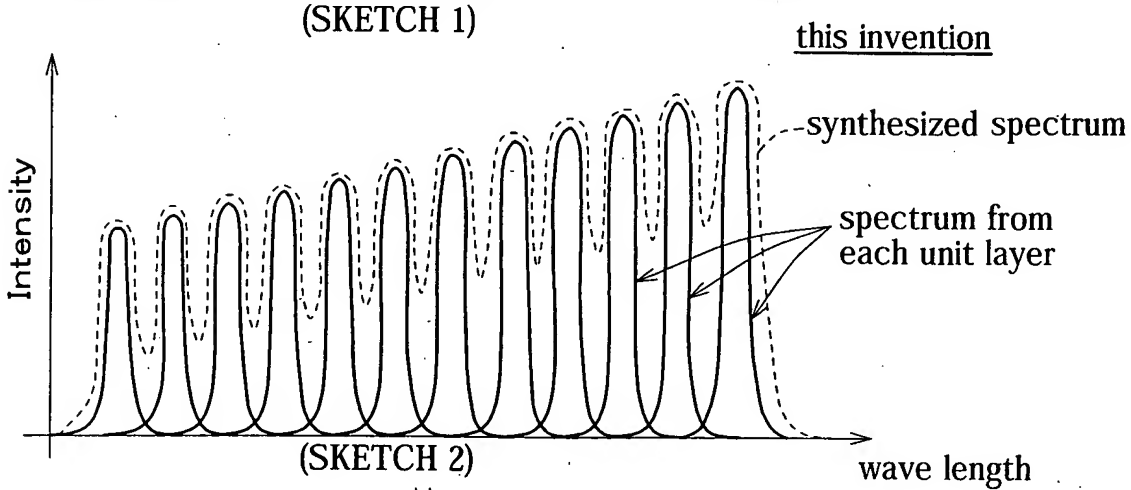
Attachment: Replacement Sheet

Annotated Sheet Showing Changes

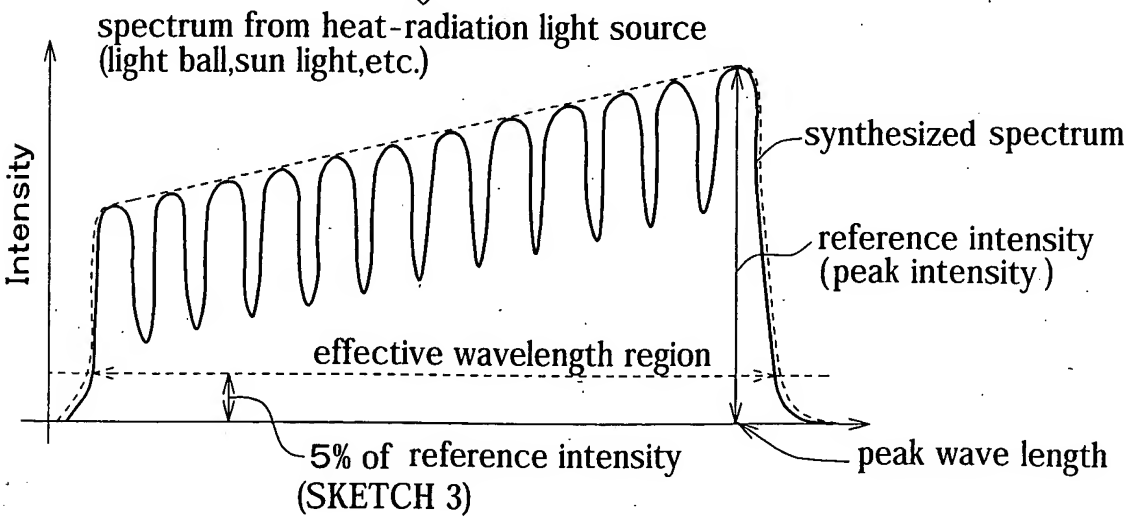
REMARKS
ATTACHED SKETCHES



(SKETCH 1)



(SKETCH 2)



(SKETCH 3)

FIG.22

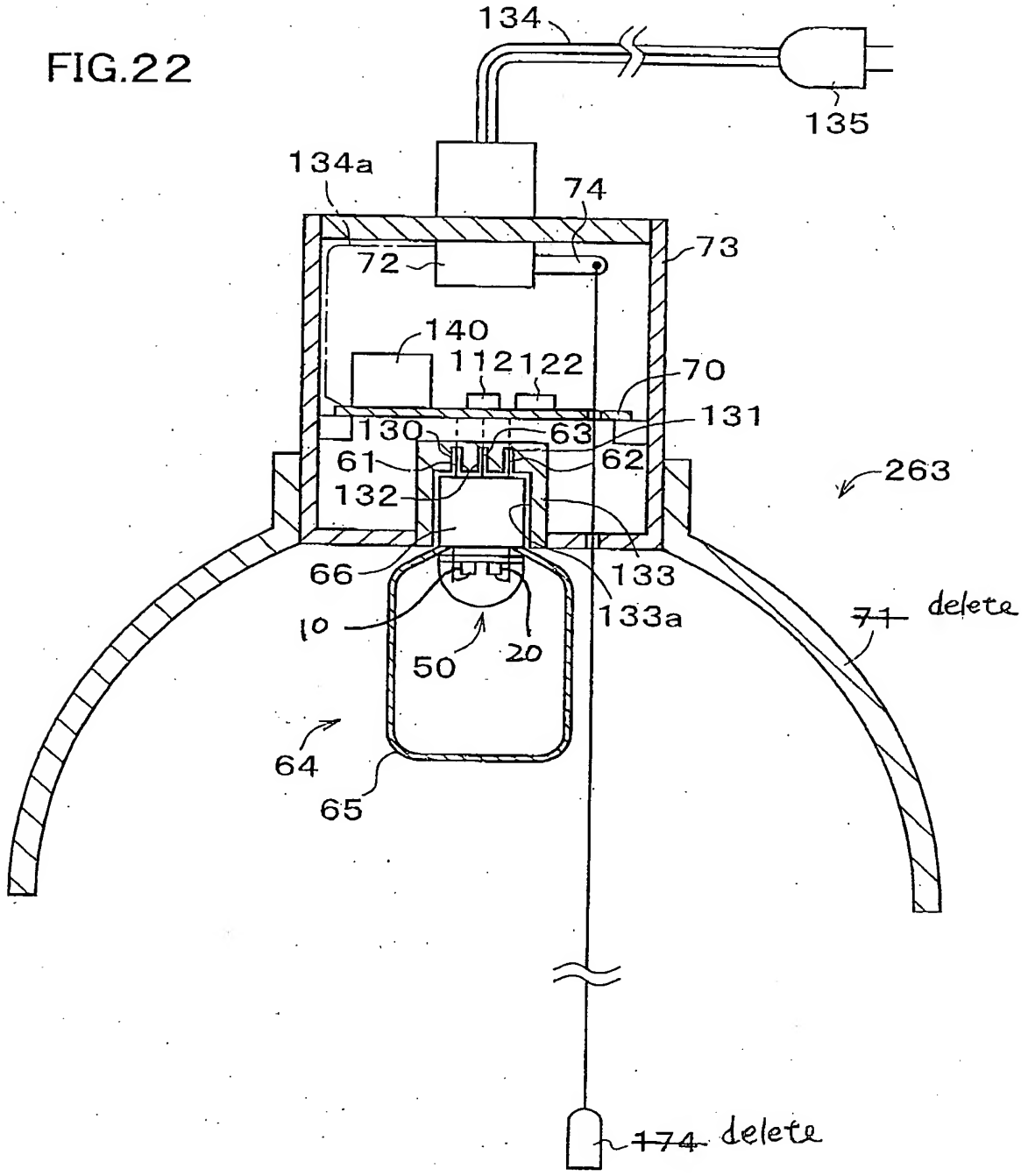

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FIG.23

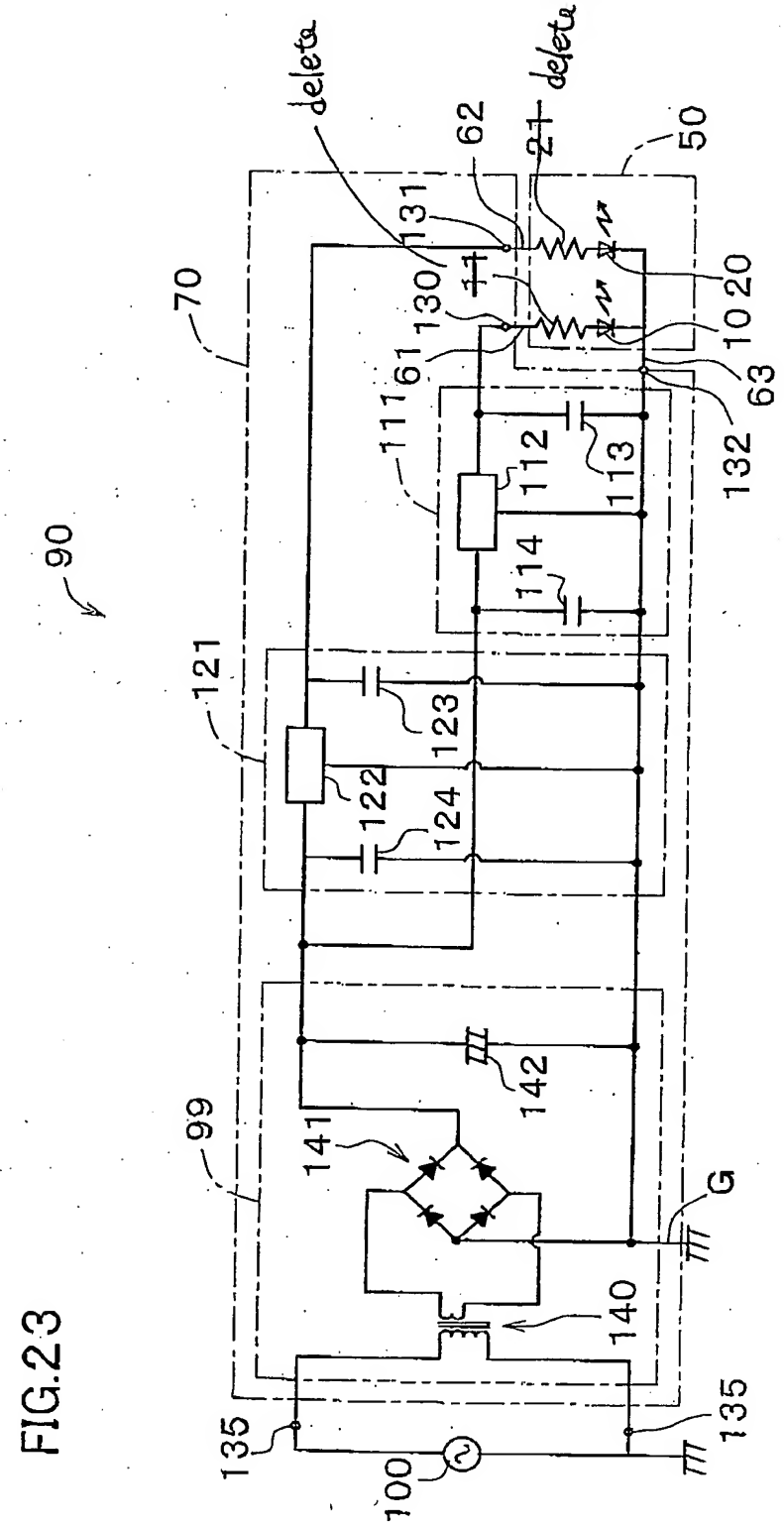
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FIG.24

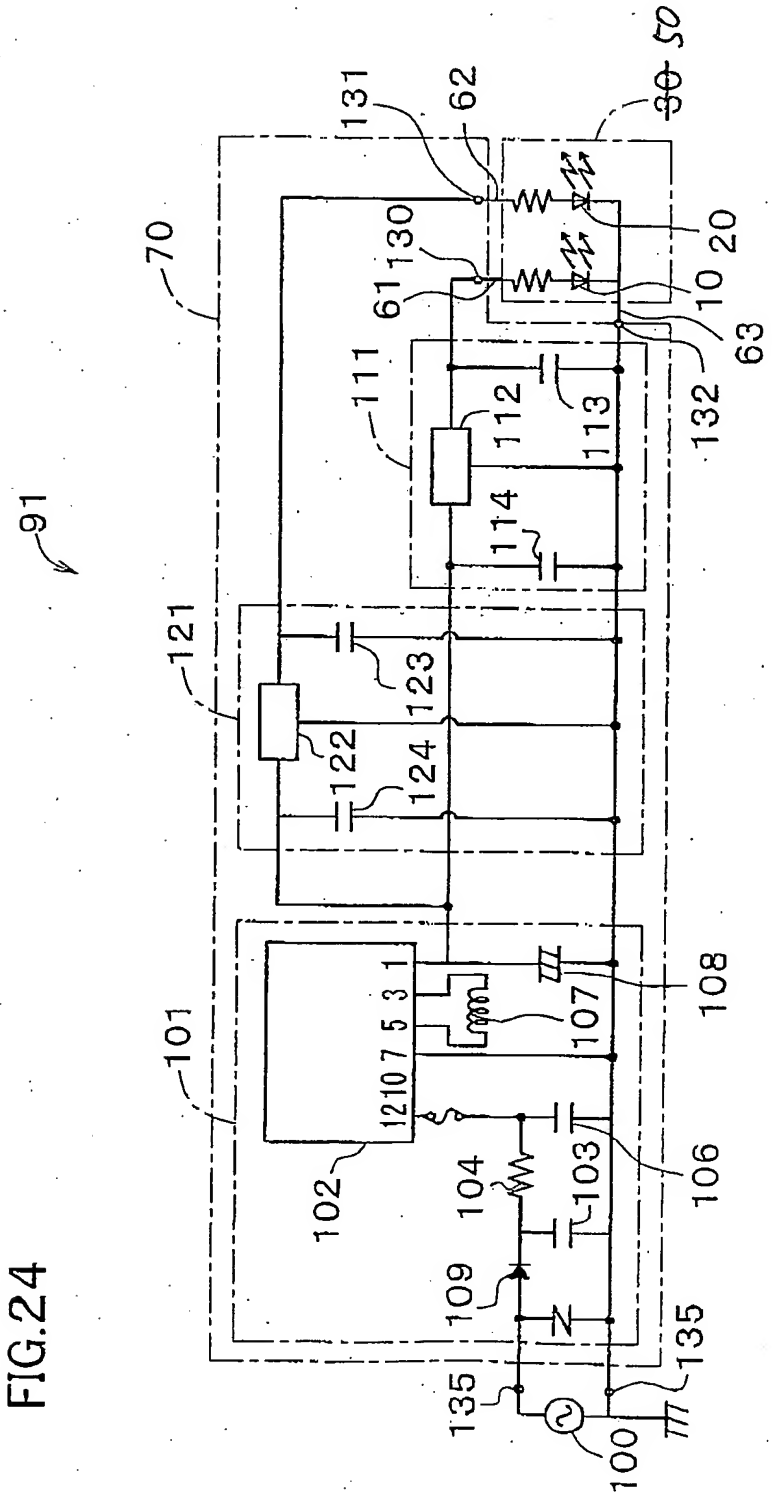
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FIG.25

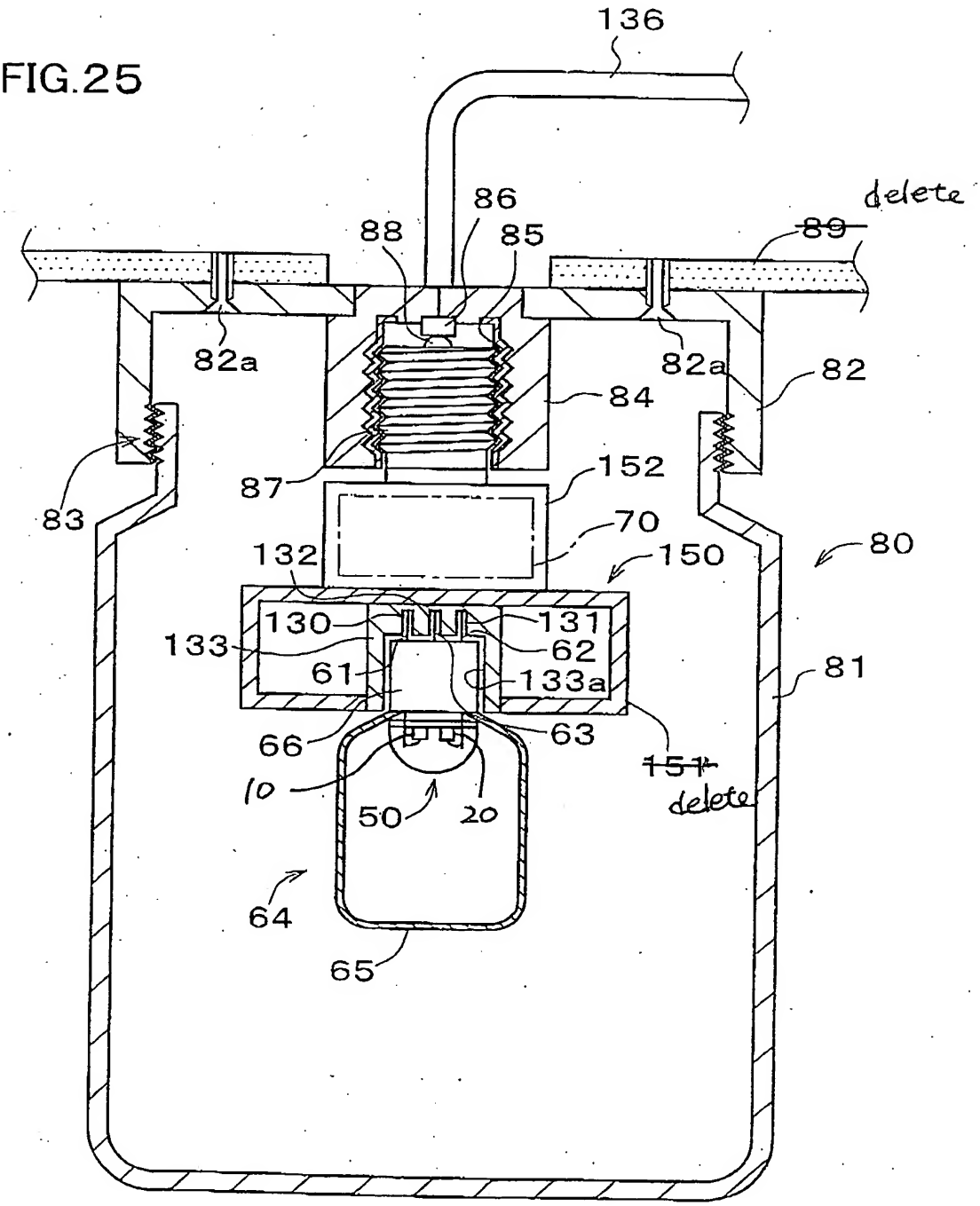
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FIG.26

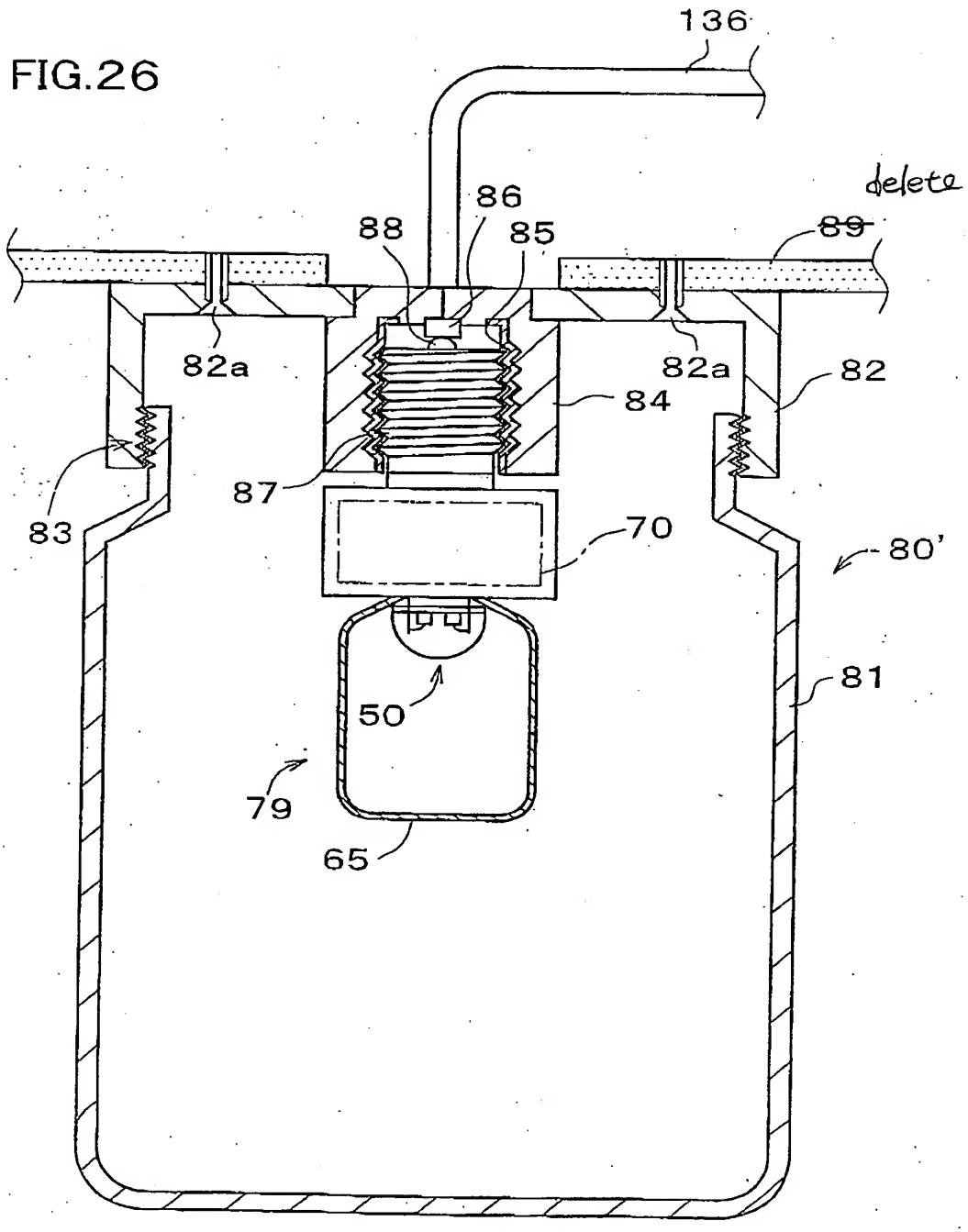

FIG.33